



# SRI CAT NEWSLETTER

Vol. 2, No. 1

July, 1995

## *From the desk of the Executive Director:*

Steady progress is being made on the storage ring commissioning with beam currents approaching 10 mA having been stored. SRI CAT commissioning has also progressed with activities associated with the 1-BM front end, with radiation shielding measurements having been made at these higher currents in Stations 1-BM-A & -B. Additional emittance measurements were also performed by the XFD diagnostics team at these higher currents.

As work proceeds on storage ring commissioning and installation of front ends and the SRI CAT beamlines, R&D activities related to SRI CAT programs continue to flourish. The previous Newsletter outlined some of the highlights of the diagnostics and nuclear resonant scattering programs. We continue along those lines in this Newsletter with articles about developments in the hard x-ray polarization program and the inelastic scattering program.

There are several changes associated with SRI CAT that I would like to bring to your attention. The first concerns an item related to ES&H activities. With the approval of the document, *Safety and Environmental Protection Policies and Practices for the SRI CAT*, we have started to implement the practices outlined within it. Perhaps one of the most significant implementations is the appointment of an SRI CAT Safety Committee. Patric Den Hartog has agreed to chair this Committee temporarily, which consists of Vladimir Kushnir, Dan Legnini, Al Macrander, and Mohan Ramanathan. Please give your support to them to make the SRI CAT sectors

and LOM offices and laboratories a safe and enjoyable place to work. Bruce Stockmeier, the XFD ES&H Coordinator, has a short note in this Newsletter further detailing the roles and responsibilities of the SRI CAT Safety Committee members.

The second change concerns the header of the SRI CAT Newsletter. The long awaited selection of the SRI CAT logo has finally been made. It appears on the header of this Newsletter and was submitted by Linda Carlson. One of the reasons for the lengthy amount of time required to select the logo was the high quality and originality of many of the designs. Thanks to everyone who submitted logo designs.

On a somewhat more personal note, we are having a change of faces in my office. Both Cheryl Zidel and Julie Wulf have recently been promoted. Along with that promotion goes a new job for both; Cheryl will be working out of the XFD Division office and Julie will be the Group Secretary for the Beamline Controls Group, headed by Tim Mooney. They both will sorely be missed by the Optics Group and SRI CAT members. They have served us above and beyond the call of duty during the last several years and have somehow been able to maintain order in the midst of the inevitable confusion and growing pains that accompany a rapid expansion of the Group and CAT activities. For this I truly thank them and wish them the best of luck in their new assignments.

These personnel changes have given me the opportunity to re-evaluate the secretarial and administrative needs of the Group and the CAT. After considering a variety of options, I have decided to dedicate one person to handle the administrative needs of SRI CAT and a second person to provide support for the Optics Group activities. We were

extremely fortunate to find two highly qualified people to fill these positions, and I would like to take this opportunity to introduce them. Pam Dalman will be taking over the responsibility of the Optics Group Secretary and Laura Bowers the SRI CAT Secretary position. As part of her new duties, Laura has also replaced Cheryl Zidel as SRI CAT newsletter editor. Pam is located in Building 362 and will move to the Central Lab Office when it is completed. Laura is located in the SRI CAT Lab Office Module, Building 431, room D005. Please take the time to stop in and introduce yourselves to them.

Unfortunately, what hasn't changed are the large fluctuations in the seasonal temperatures in the Chicago area. While writing this, we are in the middle of a brutal heat wave, with a record high of 106° F recorded recently (that's over 41° C for you metric lovers!). Therefore in order to minimize the use of unnecessary power I am voluntarily shutting off my computer now. *Dennis Mills - Executive Director SRI CAT*

**Newsflash - There will be a SRI CAT Meeting on October 17 at 8:00 p.m. here at Argonne - details will follow in a letter.**

## **Contents**

<b>From the Desk</b>	<b>1</b>
<b>Hard X-ray Polarization Program at the APS Analyzers for Inelastic X-ray Scattering Spectroscopy of Electronic Excitations</b>	<b>2</b>
<b>Safety Notes</b>	<b>7</b>
<b>Calendar</b>	<b>8</b>
<b>New People</b>	<b>8</b>
<b>Publications</b>	<b>8</b>

# Hard X-Ray Polarization Program at the APS

## Introduction

The importance of photon helicity in spin-dependent magnetic interactions has led to a great deal of effort toward obtaining high quality circularly polarized x-ray (CPX) sources. Circularly polarized photons couple with the magnetic moment of an atom, enabling them to be used to probe the magnetic properties of matter. Only recently has this coupling been demonstrated in the x-ray energy region with the observation of magnetic Compton and Bragg scattering and circular magnetic x-ray dichroism. While these techniques have shown great promise, their full development has been hampered by the lack of efficient sources of CPX.

The x-ray polarization program at the APS has focused on the development of phase retarders based on perfect crystal optics for production of CPX. Phase retarders transform linear to circular polarization by inducing a  $\pm \pi/2$  phase shift between equal amounts of incoming  $\sigma$ - and  $\pi$ -polarized radiation. These devices are normally the final optical elements before the experiment; thus they offer the greatest degree of circular polarization ( $P_c \approx 0.9$ ) incident on the sample. Further, when utilized with an undulator beam, the amount of CPX flux delivered can be comparable to that of a specialized insertion device but at a fraction of the cost. Our effort has focused on achieving the following goals:

- (a) a high degree of circular polarization
- (b) a high degree of stability
- (c) tuneability in a wide energy range
- (d) rapid switching (100 Hz) between left- and right-handed helicity.

Phase retarders can be divided into two types: low-energy (3-30 keV) devices that operate in a transmission geometry and high-energy ( $>30$  keV) ones based on the Laue reflection geometry. We have successfully developed both these types and will briefly describe the principle of their operation, the experimental results obtained, and present some planned experiments for the APS.

## Low Energy Transmission Phase Retarders

Unlike phase retarders in the visible region, x-ray phase retarders are only birefringent at or near the Bragg condition. In a transmission phase retarder, a thin crystal is deviated a fixed amount ( $\sim 10$ -100 arcsec) from the exact Bragg condition and the transmitted beam used as the CPX source (Fig. 1). The advantage of this approach is that the polarization properties change relatively slowly on the tails of the dispersion surface, as compared to the peak. Thus, the degree of collimation required in the incoming beam to obtain a well-defined polarization state is greatly relaxed. This makes this type of phase retarder extremely versatile and even allows its use on a bending magnet source without any special preceding optics other than a monochromator.

On the tails of the dispersion surface, the induced phase shift is approximated by<sup>[1]</sup>

$$= \frac{1}{2} \Gamma^2 \frac{d \sin^2 \theta}{\sin^2 \theta} \text{Re}(\mathbf{F}_H \mathbf{F}_H^*), \quad \Gamma = \frac{r_e}{V} \quad (1)$$

for both the Laue and Bragg geometries. Here,  $\theta$  is the deviation from the Bragg condition,  $\lambda$  is the wavelength,  $F_H$  is the structure factor of the reflection, and  $d$  is the length of crystal traversed by the beam. The degree of circular polarization can be expressed in terms of the phase difference  $\delta$  and the transmitted

and field amplitudes by

$$P_c = \frac{2E_\sigma E_\pi}{|E_\sigma|^2 + |E_\pi|^2} \sin \frac{\delta}{2} \quad (2)$$

Notice that, for any particular crystal thickness and photon energy, the parameter  $\delta$  can be adjusted to obtain a  $\pi/2$  phase shift and that  $\pm \delta$  results in  $\pm P_c$ . Therefore, for equally transmitted  $\sigma$  and  $\pi$  intensities, a single thin crystal can be used to obtain a nearly total circular polarization at any energy, and the helicity can be reversed by simply reversing  $\delta$ . Further, this helicity reversal can be accomplished rapidly and frequently because it involves a movement of only a few arcsec. Finally, this degree of polarization is achieved with a minimal attenuation of the x-ray beam because reasonable  $\delta$  values require thicknesses of only 1-2 absorption lengths. This phase retarder, however, is limited to energies lower than 30 keV, since above this energy the  $\delta$  value needed to obtain circular polarization is too close to the diffraction peak for reasonable absorption.

The performance of this phase retarder has been tested at the CHESS B-2 and D bending magnet beamlines. Measurements of the degree of circular polarization in the transmitted beam, as a function of  $\delta$  for a 50- $\mu\text{m}$  Si (400) crystal at 8.0 keV along with the expected theoretical curve, are shown in Fig. 2.<sup>[1]</sup> Measured circular polarization

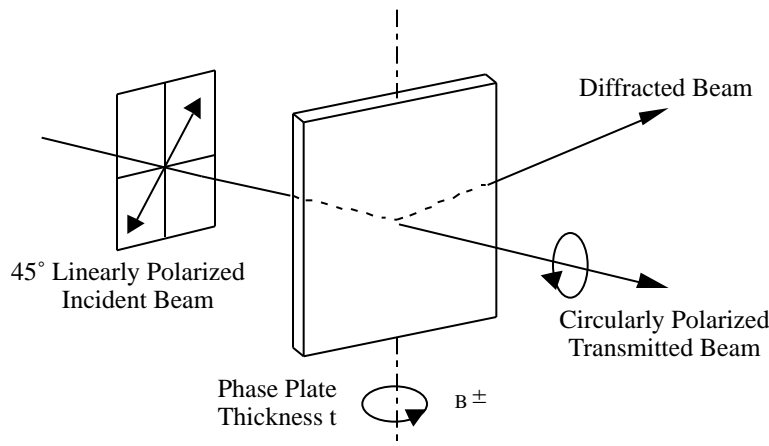


Figure 1. Transmission type phase retarder.

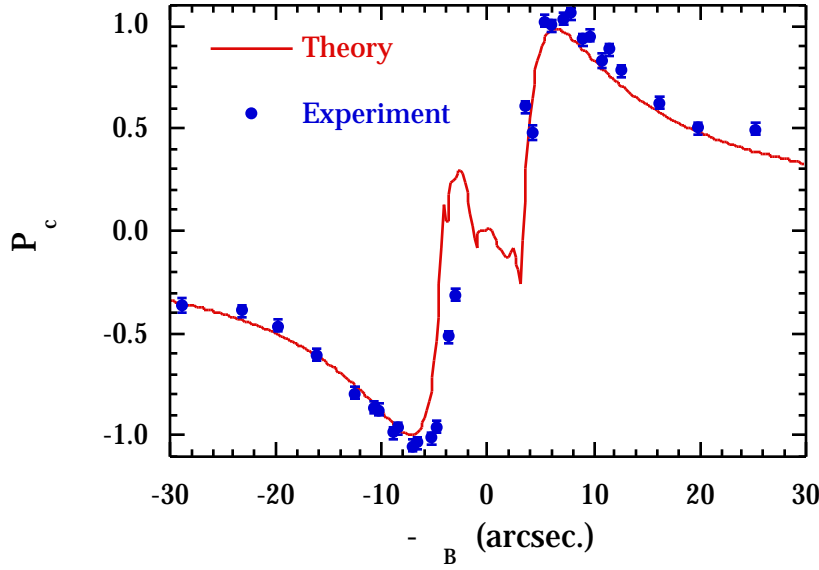


Figure 2. Measured degree of circular polarization for a 50- $\mu\text{m}$  Si (400) crystal with 8.0-keV  $45^\circ$  linearly polarized incoming x-rays.

tions higher than  $P_c \pm 0.95$  are seen on both sides of the diffraction peak, and the positions of the maximum polarizations line up well with theory.  $P_c$  was determined by profile-fitting of a GaAs (222)/(113) multibeam diffraction peak. Multibeam diffraction retains both phase and magnitude information due to interference between the coherent wave fields of each reflection, thus it can provide a direct measurement of the degree of circular polarization.[2]

#### CMXD Experiment Utilizing a Transmission Phase Retarder

We have utilized a diamond Laue (220) reflection in the transmission geometry to perform a circular magnetic x-ray dichroism (CMXD) experiment.[3] While many rare earth  $L_{2,3}$  edge CMXD spectra[4] have been taken, a complete explanation of the features in these spectra has not been put forth. Features above the absorption edge have unambiguously been assigned to the 5d states of the rare earth ion, but the origin of prominent peaks below the edge has remained uncertain. Carra and Altarelli have suggested that these peaks could be due to quadrupole transitions to the 4f band.[5] This hypothesis can be tested by measuring the angular behavior of the CMXD spectra. The 2p-5d dipole transition and the 2p-4f quadrupole transition should exhibit different angular dependencies of the following form,

$$\mu_c^{E1} = D \cos \theta \quad (3)$$

and

$$\mu_c^{E2} = Q \cos \theta + \frac{1}{2} Q (5 \cos^2 \theta - 3) \cos \theta, \quad (4)$$

where  $\theta$  is the angle between the beam and magnetization direction,  $D$ ,  $Q$ ,  $Q$  are angle-independent coefficients, and  $\mu_c = \mu_c^{E1} + \mu_c^{E2}$ . Therefore, by taking spectra at different angles and dividing through by  $\cos \theta$ , the dipolar contributions should be constant while the quadrupolar ones should exhibit additional angular dependence. Numerous attempts[4,6] have been made to observe this angular dependence but none demonstrated any behavior be-

yond dipolar. A possible explanation for this discrepancy between theory and experiment was suggested by König et al.,[7] who noted that magnetic disorder greatly diminishes the weight of  $Q$  relative to  $D$  in eq. 4. Therefore, observation of the quadrupolar angular dependence requires almost complete magnetic alignment,  $M \sim 90\%$ . To achieve these high magnetizations, spectra must be taken with high fields and low temperatures where magnetization reversal is difficult. Thus a phase retarder is indispensable in performing this experiment since it must be done by helicity rather than magnetization reversal.

The normalized dichroic spectra at the Dy  $L_3$  edge of DyTb for  $\theta = 35^\circ$  and  $65^\circ$  are shown in Fig. 3. A clear deviation from  $\cos \theta$  behavior is shown in the negative feature below the edge. This deviation is consistent with theoretical predictions and is the first experimental evidence demonstrating the quadrupolar nature of this pre-edge structure.

#### High Energy Phase Retarder

For energies greater than 30 keV, a phase retarder based on a Laue reflection must be used. On the Bragg condition, the phase lag between the  $\mathbf{E}$  and  $\mathbf{H}$  wave fields is given by

$$= \Gamma F_H d \frac{(1 - \cos^2 \theta_B)}{V}, \quad \Gamma = \frac{r_e}{V}. \quad (5)$$

While this equation is similar to eq. 1, the parameter  $\theta_B$  has been eliminated.

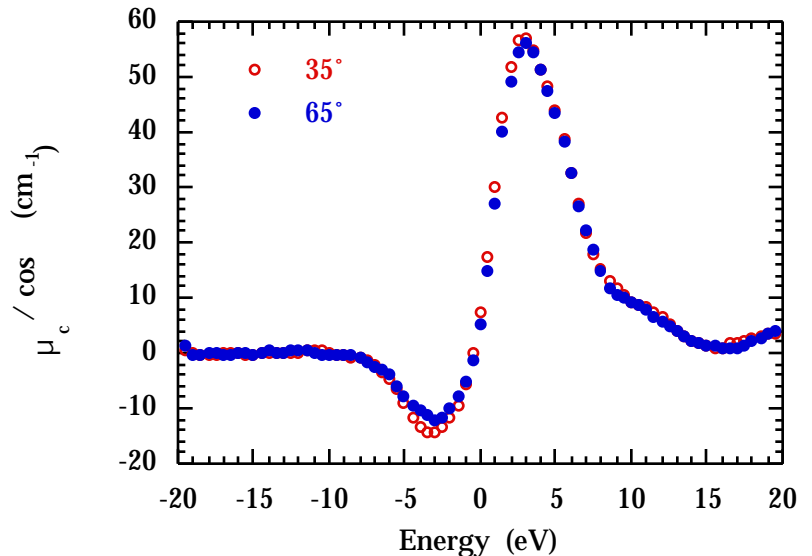
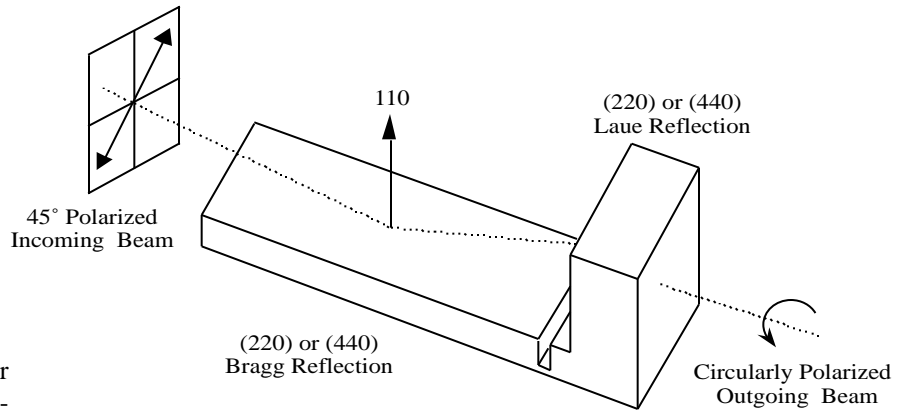


Figure 3. Normalized dichroic signal at the Dy  $L_3$  edge of DyTb.

Figure 4. Bragg-Laue crystal for the production of high energy circularly polarized x-rays.



Therefore, this type of phase retarder can only yield  $\pi/2$  phase shifts at discrete energies determined by the thickness  $d$ . For this type of phase retarder, we have cut a monolithic germanium (110) Bragg-Laue crystal (see Fig. 4). Germanium was used because the phase shift for high-Z materials changes slowly over the width of the Laue reflection yielding the maximum  $P_C$ . In this design, white synchrotron beam is incident on the Bragg portion of the phase plate and then reflected by the Laue portion. The phase lag is induced entirely in the Laue portion of the monolith and the Bragg portion simply serves to preserve the direction of the beam. By diffracting at  $45^\circ$  to the horizontal, the natural polarization of the synchrotron beam provided equal  $x$  and  $y$  components in the incoming beam.

The performance of this phase retarder was tested by measuring the linear polarization of the outgoing beam as a function of energy for a (440) reflection with an 8-mm-thick Laue portion. Minima in the linear polarization and thus maximum  $P_C$  were found at 65 keV and 88 keV, in agreement with theory. The presence of CPX was verified by measuring the magnetic Compton profile of Fe at these energies, given that  $P_C \sim 0.90 \pm 0.04$ .<sup>[8]</sup>

#### MCS Experiment Utilizing the High Energy Phase Retarder

We used the high energy phase retarder to perform magnetic Compton scattering (MCS) experiments on invar alloys. Invar alloys have a nearly constant thermal expansion coefficient near room temperature. Although these alloys have been studied extensively for many years, the physical mechanism behind this effect has not been conclusively determined. Models<sup>[9]</sup> have suggested that magnetism can play a key role in

this behavior, i.e., the system responds to the temperature increase by a magnetic phase transition rather than by the usual lattice constant increase. MCS is an ideal probe for the study of magnetic phase changes such as this because it yields information on both the macroscopic and microscopic magnetic properties. Macroscopic features are determined from the integrated Compton profile, while microscopic properties are inferred from the shape of the profile.

We have also performed a series of MCS experiments on Fe<sub>3</sub>Pt. This system is an excellent model for the study of binary invar alloys, because it possesses both ordered and disordered phases, which help eliminate effects due to magnetic inhomogeneities. Our initial results have shown that, above their respective critical temperatures, a transition occurs in which the average mag-

netic moment per atom changes from the room temperature value of  $M = 1.8 \mu_B$  to  $M = 0.6 \mu_B$  at  $T = 490\text{K}$  for the ordered sample, and from  $M = 2.8 \mu_B$  to  $M = 0.6 \mu_B$  at  $T = 410\text{K}$  for the disordered sample (Fig. 5). These measurements conclusively demonstrate the presence of a remanent magnetic moment in the high temperature state which, until now, had been an unresolved issue. A substantial change in the shape of the MCS profile has been also observed. Qualitatively, the results for the disordered sample are consistent with a decrease of the d-like moment of the Fe atoms. Currently, band structure calculations are in progress in order to gain a quantitative understanding of which electron shells are involved.

#### Future Work at the APS

In the future we plan to investigate resonant magnetic diffraction using cir-

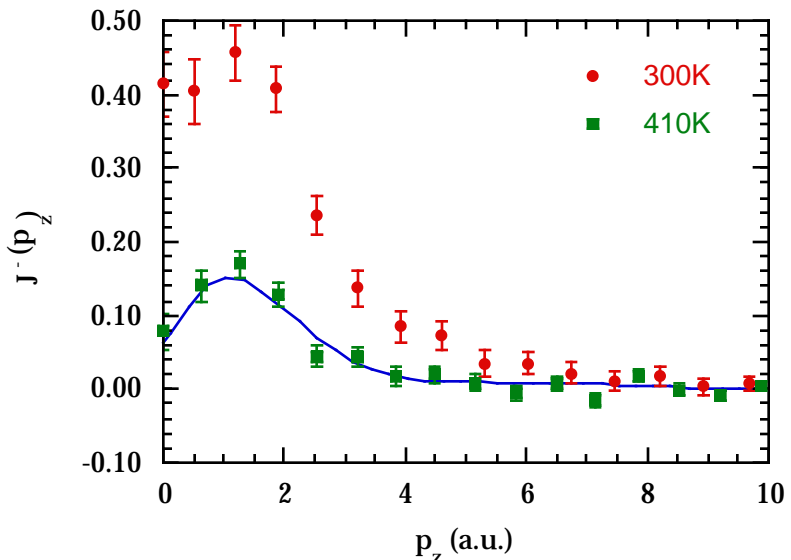


Figure 5. Magnetic Compton profile for disordered Fe<sub>3</sub>Pt at 300K and 410K. Line shown to guide the eye.

cular polarization to measure the dichroic signal in the resonant and nonresonant Raman spectra using the low energy phase retarder. Among the systems that we expect to study are AlPdMn quasicrystals,  $\text{Sm}_2\text{Mn}_2\text{Ge}$ , and Ho. Using the high energy phase retarder, we plan to continue high temperature magnetic Compton studies and also to extend these experiments to low temperatures and to magnetically hard materials.

Jonathan C. Lang and George Srajer

## References

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## Analyzers for Inelastic X-ray Scattering Spectroscopy of Electronic Excitations

Inelastic x-ray scattering spectroscopy (IXSS) is an exciting field. While the history of IXSS started with the discovery in 1923 of the Compton effect, the study of collective excitations became possible only in the late 1960s with rotating anode x-ray sources. Even at that time however, experiments were difficult because of the very low signal levels. It was the advent of synchrotron radiation that realized the potential of this field.

A typical experimental scheme for IXSS is shown in Fig. 1. A specimen is illuminated with an x-ray wave of frequency  $\omega_0$  and wave vector  $\mathbf{k}_0$ , while the scattered intensity is measured with an analyzer at frequency  $\omega_1$  and wave vector  $\mathbf{k}_1$ . Thus, one measures the scattering by the wave of electron density in the solid with frequency  $\omega = \omega_1 - \omega_0$  and spatial frequency  $\mathbf{q} = \mathbf{k}_1 - \mathbf{k}_0$ . The experiment therefore consists of measuring the differential scattering cross section as a function of  $\mathbf{q}$  and  $\omega$ . Unlike the scattering of electrons, inelastic x-ray scattering is weak, so the measured spectra are not complicated by multiple scattering; we definitely probe the bulk of the specimen. Unlike neutron scattering, one can vary  $\mathbf{q}$  and  $\omega$  practically independently within wide limits. However, the intensity is still very low in IXSS, which makes experiments difficult even with the use of existing synchrotron sources. The measured signal is typically on the order of a few counts per minute using low-atomic number materials. With the the

new third-generation synchrotron sources, these rates are expected to increase substantially.

What makes research in this field interesting is that there is no established theoretical picture that would describe the whole set of existing experiments. Existing theoretical works include, on the one hand, properties of the electron liquid itself with no regard to the lattice effects (the jellium model), and on the other, the band structure effects. Yet neither model is complete. Thus far, IXSS experiments at synchrotron sources have been carried out with an energy resolution of about 1 eV because of the small signal. To distinguish between the different proposed models, it is necessary to cover a wide range of  $\mathbf{q}$  in reciprocal space in different directions and to do so with good statistics. Most of the band structure features are in the range of a few eV, so an energy resolution of 0.1 eV would open tremendous new opportunities for IXSS. Because they will provide increased sig-

nal rates, the new generation of synchrotron radiation sources — ESRF in Europe, APS in the USA, and SPring-8 in Japan — gives us the opportunity to carry out such extensive IXSS measurements.

IXSS experiments are currently being prepared for the ID beamline of Sector 3 at the APS. SRI CAT activity in this field is subdivided into two program: scattering on phonons with energy transfers on the order of a few meV to 1 eV with an energy resolution of a few meV, and IXSS of electronic excitations with energy transfers up to 100 eV and an energy resolution from 1 eV to 0.1 eV. In the first case, the goal is to achieve as high a resolution as possible. In the latter case, the scattering cross-section is much smaller, so the goal is to make an analyzer with a broad enough bandwidth in order to preserve the x-ray beam intensity.

Monochromatization of the incoming beam to 100 meV can easily be done with a standard channel-cut monochro-

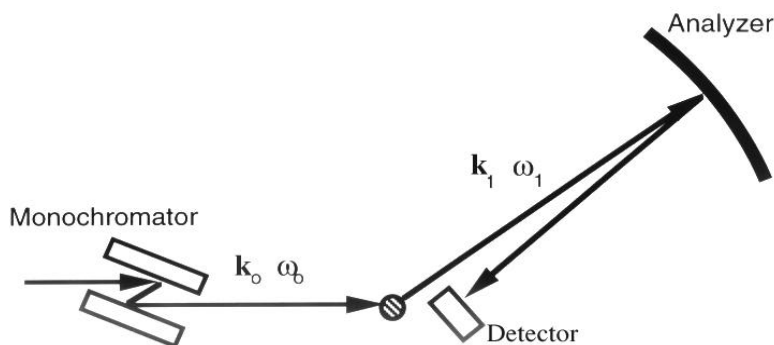


Figure 1. Optical scheme of an IXSS experiment.



mator because the angular divergence of the x-ray beam emitted from an undulator is well matched to the angular acceptance of a perfect Si crystal. Energy analysis of the scattered wave is more challenging because it is a spherical wave emitted from a small region (1-2 mm). Our solution is to use a back-scattering analyzer geometry, i.e., in which the Bragg reflection from the crystal is at an angle very close to  $90^\circ$ . In this regime, the angular width of the reflection becomes extremely large

$$d\theta_{BS} = \sqrt{\chi_{hkl}},$$

and the energy resolution is equal to

$$\frac{dE}{E} = \chi_{hkl},$$

where  $\chi_{hkl}$  is the Fourier component of the crystal polarizability. Thus, the Bragg angle is fixed, and we can now choose the reflection (i.e., photon energy) and the crystal material. It turns out that, with back-scattering, it is difficult to obtain a large bandwidth. For instance, if we choose a silicon crystal and an energy of 7.9 keV (which corresponds to the back reflection of Si(444)), the energy resolution of the analyzer is 37 meV. We therefore decided to use germanium for the analyzer crystal instead of silicon. Because of its higher atomic number, the bandwidth of the Ge(444) back-reflection is  $dE = 80$  meV.

In order to collect over a large solid angle, it is necessary to use a spherically bent crystal. But bending introduces stress, so the d-spacing changes with the depth inside the crystal. This makes the energy resolution curve wide and asymmetric as shown in Fig. 2. This is an undesirable effect because this peak will be observed as an elastic one, which usually has an intensity several orders of magnitude larger than the inelastic signal, and its asymmetric tail will distort the measured spectra. As can be seen from the figure, the broadening and asymmetry are much smaller for bent germanium than for silicon. The reason for this is that it takes a much thinner layer of Ge to reflect the radiation back, therefore the d-spacing gra-

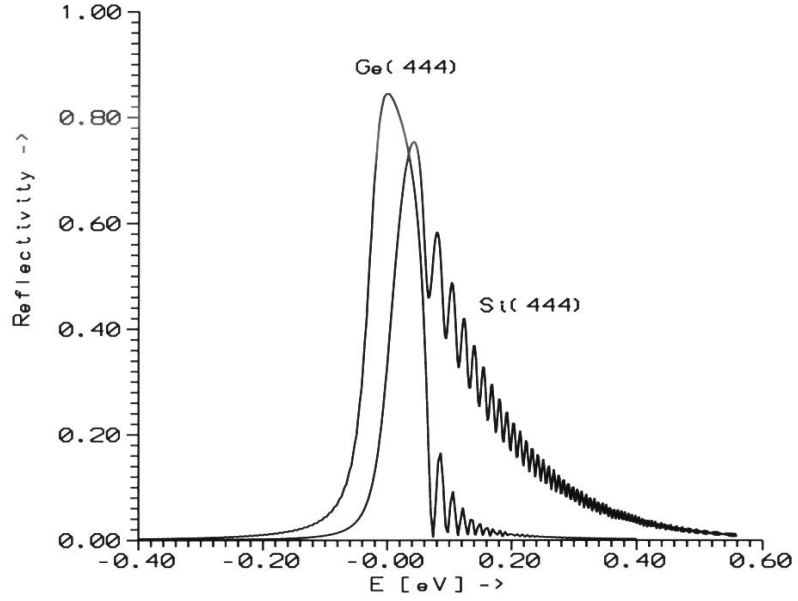


Figure 2. Calculated reflectivity curves of Si and Ge spherically ( $R=1m$ ) bent analyzers.

dient has a smaller effect on the shape of the peak. Also, the larger absorption of x-rays in Ge suppresses diffraction from deeper layers of the material with different d-spacing.

Despite the benefits of using Ge, all such analyzers produced previously were made of silicon, probably because it is difficult to find large diameter, good quality boules of Ge, while Si is easily available. Fortunately we obtained a dislocation-free, 105-mm diameter, nearly cylindrical boule of Ge from Sogem-Afrimet Inc. of Belgium.

The Ge analyzer is shown in Fig. 3. The germanium wafer was bent into a sphere by gluing it onto a concave sub-

strate with epoxy. The substrate is a plano-concave spherical glass lens with a curvature of 1 m and  $\lambda/4$  peak-to-valley accuracy. The Ge wafers had a thickness of 0.55-0.60 mm. It is difficult to bend thicker wafers — their rigidity goes as a cube of the thickness — but wafers that are too thin are sensitive to every dust particles. Special precautions were taken to avoid dust between the crystal and lens as well as air bubbles trapped in the epoxy. The crystal orientation was Ge(111). We have also prepared a smaller analyzer with a Ge(311) orientation for our collaborator from Bell Labs, Eric Isaacs. The parameters of our analyzer preparation

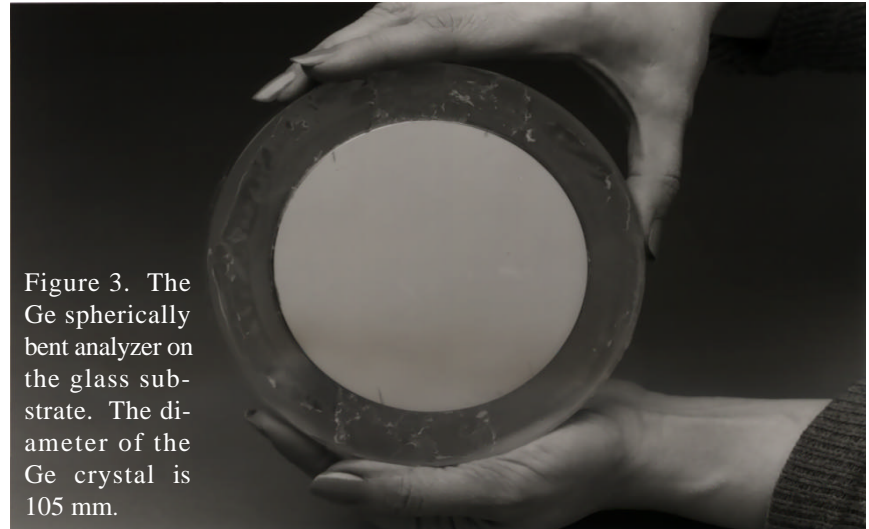


Figure 3. The Ge spherically bent analyzer on the glass substrate. The diameter of the Ge crystal is 105 mm.

method, for example, the crystal thickness, cleaning procedures, and applied pressure, were developed more from experience than theory; our success rate is 60-70%.

The figure quality of the analyzer was measured with x-rays. In the central 80 mm, the average angular deviation of the crystal lattice from a perfect sphere is less than 0.5 mrad. The intrinsic reflection width of Ge(444) in the back-scattering geometry is  $\pm 3.4$  mrad, so broadening due to the shape of the ana-

lyzer is negligible.

A smaller Ge analyzer was tested at CHESS together with a channel-cut Si(620) monochromator. The Ge device showed a total energy resolution of 0.3 eV. However, the divergence of the incoming beam at CHESS was much larger than the anticipated divergence of APS undulators, so we expect better resolution at the APS.

In the future, we plan to develop analyzers of different designs for different energies and to provide better energy

resolution and focusing. One design proposed by Dr. Popovici is a special nonspherical analyzer that will not introduce broadening of the energy-resolution curve. We look forward to the first inelastic x-ray scattering measurements on electronic excitations in various systems with the new and unique opportunities that will be available soon at the Advanced Photon Source.

*Vladimir Kushnir and Albert Macrander ¶*

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## **Safety Notes**

### **SRI CAT SAFETY SUPPORT PERSONNEL**

The following SRI CAT members have important roles in the SRI CAT safety program.

#### **SRI CAT Safety Coordinator - Patric Den Hartog, extension 3722**

Pat is responsible for administering the SRI CAT safety and environmental protection program. These responsibilities include chairing the SRI CAT Safety Committee and leading the committee on its monthly inspections of SRI CAT facilities. The SRI CAT Safety Coordinator reports directly to SRI CAT Executive Director Dennis Mills.

#### **SRI CAT Chemical Safety Coordinator - Al Macrander, extension 5672**

Al, who chairs the XFD Chemical Safety Committee, is responsible for helping to identify safeguards needed to safely store, handle, use, and dispose of chemicals. He is also responsible for helping ensure that safety and personal protective equipment used by SRI CAT members is appropriate.

#### **SRI CAT Electrical Safety Coordinator - Vladimir Kushir, extension 0162**

Vladimir's responsibilities include reviewing temporary electrical installations and experimental equipment for electrical safety concerns, helping ensure SRI CAT adherence to ANL lock-out and tag-out requirements, and identifying safeguards required while working on or near energized components.

These SRI CAT members will continue to receive support from XFD ES&H including Secretary Clareen Chojnowski (ext. 6746), Administrative Assistant Meg Noreuil (ext. 2787), ES&H Specialist Bill Wesolowski (ext. 0169), and ES&H Coordinator Bruce Stockmeier (ext. 9394).

### **INSTALLATION & MAINTENANCE PLANNER**

Using information provided by SRI CAT members, the APS has formulated a database that SRI CAT personnel can use to identify hazards associated with their construction and installation activities and to choose appropriate control measures. The Installation & Maintenance Planner (I&MP) is based on FileMaker Pro®, a software program that runs on Macintosh computers. For each planned activity, the user enters responses to a series of questions displayed on two successive screens, designated "Hazard Identification" and "Hazard Controls." The I&MP uses these responses to generate two activity summary screens, which, when printed out, constitute a two-page safety plan for that activity. The supervisor responsible for the activity can use the summary as a checklist specifying required hazard controls that must be in place before the work starts and as a list of hazards to be described to workers at meetings preceding the work in question. For more information on this contact Bruce Stockmeier (ext. 9394) or Laura Bowers (ext. 0160).

## Calendar

**Oct. 16, 1995 - APS**

**X-ray Centennial Symposium, ANL.**

**Oct. 17-20, 1995 - Syn-**

**chrotron Radiation Instrumentation '95, ANL.**

**Oct. 17-18, 1995 - Seventh Users Meeting for the Advanced Photon Source, ANL.**

**Oct. 18, 1995 - SRI CAT Meeting, ANL.**

## Who's New

**Dr. Derrick C. Mancini - Assistant Physicist.** Dr. Mancini has joined the Sector 2 staff to work on the 2BM beamline, primarily on deep x-ray lithography for micromachining. He previously worked at the MAXLab Synchrotron Radiation Laboratory in Lund, Sweden. There, he initiated the program in x-ray lithography, designed and constructed soft x-ray monochromator beamlines, and continued research in soft x-ray emission spectroscopy that he began as a research fellow at Uppsala University in Sweden. He completed most of his graduate studies in x-ray lithography at UW-SRC and gained his first experience with synchrotron radiation as an operator at CHESS.

**Laura Bowers** - Laura joins SRI CAT in the capacity of CAT Secretary. Although we use the word "secretary" in the job title, Laura will be assisting the CAT Directors in administrative and safety issues in addition to providing secretarial support to the CAT members who are residing in the LOM. Laura has been at ANL for 15 years, most recently as an administrative secretary in the Chemistry Division.

## Publications

Gluskin, E., K. J. Randall, I. McNulty, W. Yun, A. M. Khounsary, and B. Lai, "Soft X-ray Instrumentation and Its Applications at the Advanced Photon Source," *Journal of X-ray Sci. Technol.* **5** (1995) 29.

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Address additions, changes and deletions are welcome. Forward them to the SRI CAT Secretary.

Newsletter formatted by Cheryl Zidel  
Thank you Susan Picologlou

Next Issue - October 1995